CALIFORNIA DIVISION OF MINES AND GEOLOGY
SUPPLEMENT TO FER-137

Hunting Creek fault, Lake, Napa, and Yolo Counties

by

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INTRODUCTION

Segments of a generally north-trending, right-lateral strike-slip fault located east of Lower Lake and west of Knoxville were referred to as the Hunting Creek fault in Fault Evaluation Report FER-137. Traces of the Hunting Creek fault were recommended for zoning for special studies. New data has become available since FER-137 was prepared and are presented in this supplement.

SUMMARY OF NEW DATA

A detailed fault evaluation study along segments of the Hunting Creek fault in the Jericho Valley 7-1/2 minute quadrangle was conducted jointly by Steffen, Robertson, and Kirsten (SRK) and Woodward-Clyde Consultants (WCC) for the Homestake Mining Company (SRK-WCC, 1983). Detailed geologic mapping along the fault, air photo interpretation, and trenching of specific fault traces were accomplished between December 1982 and March 1983. Results of these investigations were released in a report prepared for the McLaughlin Project on April 6, 1983. The SRK-WCC investigation confirmed that segments of the Hunting Creek fault are near-vertical, right-lateral strike-slip faults. SRK-WCC basically concurs that the Hunting Creek fault is well-defined, and they do not differ significantly with CDMG regarding the location of fault traces. SRK-WCC contend that the Hunting Creek fault is not associated with the Green Valley fault to the south, based on the lack of evidence for a continuous fault zone between these two faults. In addition, the zone of seismicity that was associated with the Hunting Creek fault by Herd (1981) may be west of the fault. However, these arguments are peripheral to the principal concern regarding the decision to zone segments of the Hunting Creek fault: are the segments proposed for zoning for special studies well-defined and sufficiently active?

SRK-WCC (1983) contend that geomorphic features delineating the Hunting Creek fault, though well-defined, are not indicative of Holocene-active faulting. They contend that the ridge where trench 5 is located is not offset and that the deflected drainages are not diagnostic of Holocene activity because the drainages are entrenched in bedrock millions of years old. SRK-WCC ignore supporting geomorphic features associated with the deflected drainages, such as a sidehill bench, linear troughs, and beheaded drainages, some of which are ephemeral and must be very young (figure 2a). The drainages are systematically deflected right-laterally, along with deflected and dragged(?) ridges, all indicating that recent right-slip faulting has produced these features, even though erosion may have enhanced some of the larger geomorphic features.

Locations of trenches excavated by WCC along segments of the Hunting Creek fault are shown on figure 5. SRK-WCC divided the Hunting Creek fault into 3 segments: the Rieff Road, Dunnigan Hill, and Mysterious Valley segments. Trench explorations were located along the Rieff Road and Dunnigan Hills segments. Briefly, evidence of a faulted paleosol estimated by WCC to be between 32,000 and 75,000 years old was observed in trench 3 and test pits 1A and 3A along the Rieff Road segment of the Hunting Creek fault. WCC states that overlying Holocene colluvium is not offset by the fault. It was concluded by WCC that definitive evidence of Holocene displacement was not observed along the Hunting Creek fault, although they state that it was not possible to demonstrate that there has been no Holocene displacement along the fault, based on the lack of geomorphic features indicative of recent faulting. However, an annotated map of fault related geomorphic features was not included in the SRK-WCC report, even though the trench was located across the north end of a linear trough and other ephemeral features commonly associated with recent right-slip faulting (see figure 2a).

CDMG staff (E. Hart, R. Sydnor, and W. Bryant) inspected trenches excavated by WCC along the Rieff Road and Dunnigan Hill segments of the Hunting Creek fault. There are significant differences in the interpretation of features exposed in trench 3 between WCC and CDMG (figure 6). WCC concludes that recent (Holocene) colluvium (unit 2) is not offset by the fault, and they limit the age of displacement as post-32,000 to 75,000 years and pre-recent colluvium (Holocene). However, CDMG contends that there is evidence supporting the interpretation that the Holocene colluvium is offset. Unit 2 is truncated against unit 3, and the unit 2 colluvium has an apparent vertical separation across the fault of about 10 to 20mm, up on the east. Moreover, unit 3 clearly penetrates and is located stratigraphically higher than units 1 and 2 along the western fault strand. Because unit 3 is beveled 3 meters west of the fault by unit 2, some degree of erosion has occurred before unit 2 deposition. If the deformation of unit 3 occurred before it was eroded and subsequently buried by unit 2, one would not expect this penetration to have remained. Because shears were not observed in the colluvium does not preclude the possibility that it has been displaced by faulting. Indeed, the majority of evidence in this trench supports the conclusion that Holocene-age material is offset.

The Hunting Creek fault was observed by Hart and Bryant in test pit 1A in December 1982 and April 1983. WCC states that a near-vertical shear (N-S strike) extends into a paleo-B soil horizon, but that it does not offset younger colluvium. However, Hart and Bryant observed 2 shears about 3 feet apart. Dark brown colluvium on the west is juxtaposed against light brown "weathered sedimentary rock" (CDMG interprets this material as older colluvium) on the east. The recent colluvium east of the fault is characterized by a well-defined stoneline at its base. This stoneline was not observed west of the fault, indicating that the stoneline may be disrupted by faulting. A log of test pit 1A was not included in the SRK-WCC report. However, a very generalized diagram of features observed December 27, 1982 by this writer is presented in figure 7.

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Trenches 5 and 6 were excavated along the Dunnigan Hill segment of the Hunting Creek fault (figure 5). Evidence of strike-slip faulting in brecciated serpentine was exposed in trench 5. The general trend of the fault plane was slightly curved which explains the 76°NW dip shown on the trench log (figure 8). Although striations are reported as plunging 12°N, Hart measured a 3°N plunge, indicating that striations vary somewhat but are essentially sub-horizontal. Shears were not observed in the overlying paleosol (unit 3), although the base of the paleosol apparently thickens or is disrupted across the fault and the older soil units appear gradational with each other and with the bedrock "gouge." Many soil-filled fissures occur west of the principal(?) fault, and it is possible that the ridge has undergone extension during faulting events, resulting in a zone of complex distributive shearing. In addition, the older soil units are truncated west of the logged section of the trench, where topsoil rests directly on bedrock.

A well-defined vertical fault plane was not observed in trench 6, although a paleosol (unit 3) thickens over a unit described as sandy serpentine gouge (unit 5) and may indicate faulting. The data are inconclusive, and the log of trench 6 is not included here.

Trenches were not excavated across traces of the Mysterious Valley segment of the Hunting Creek fault (figure 5). Thus, new data relevant to recency of faulting was not developed along this segment of the Hunting Creek fault.

The lithology exposed in the SRK-WCC trench excavations consists predominantly of sheared and brecciated serpentine. Clasts and blocks of metadiabase and silica carbonate occur in the serpentine, generally as knockers. Often it is difficult to identify structures and stratigraphy in this extremely complex lithology. Thus, well-defined, vertical fault planes may not always be present, especially in serpentine breccia.

Slip rates of between 0.09 and 0.04mm/yr were calculated by WCC for the Hunting Creek fault. The calculated slip rate seems to be based on unwarranted assumptions regarding the small, apparent vertical separation of the paleosol and the plunge of striations observed in trench 3 (only one observation reported). WCC estimated that no more than about 2.8 meters of post-paleosol, right-lateral strike-slip faulting has occurred along the Hunting Creek fault. Unit 4 (sagfill, and clay gouge) observed in trench 3 is ignored in the calculations, even though the unit is either extensively faulted or younger than unit 3, or both. A net slip of 2.8 meters could not possibly have created such notable truncations and offsets with so little strike-slip movement. Youthful geomorphic features are also ignored in the slip calculations. This geomorphic evidence suggests a slip rate on the order of 0.5 to 1.0mm/yr, based on comparison with the Greenville and other strike-slip faults having relatively low slip rates (Sweeney, 1982; Wright et al., 1982). If the calculated slip rate was correct, then the downhill movement of soil would completely obscure any slow-forming ephemeral geomorphic features. However, youthful and ephemeral geomorphic features do exist along the fault and were used to identify the precise location and recency of faulting at several locations (figure 2a).

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Averitt (1945) mapped a north-northwest-trending fault north of Hunting Creek that corresponds fairly well with the southern portion of the Dunningan Hill segment of the Hunting Creek fault. This reference was inadvertently overlooked when FER-137 was originally prepared. North of the Knoxville-Lake Berryessa Road, Averitt also mapped a fault that corresponds to the Rieff Road segment of the Hunting Creek fault. These faults mapped by Averitt are generalized, but it is significant that he maps major geologic units as truncated by the fault corresponding to the Rieff Road segment. The magnitude of displacement could not be determined.

E.W. Hart and this writer interpreted 1952 USDA air photos that were not available when FER-137 was written. Minor differences in detail exist between traces depicted on the SSZ maps of the Jericho Valley and Knoxville quadrangles and the fault traces mapped by Bryant and Hart on figures 2a,2b. However, these differences basically reflect the differences in scale and resolution of the air photos and do not mandate significant changes in the SSZ boundaries. Minor changes, however, have been made on figures 2a and 2b.

CONCLUSIONS

The Hunting Creek fault, recommended for zoning for special studies in FER-137, is a generally well-defined, right-lateral strike-slip fault. A fault evaluation investigation by SRK-WCC (1983) conducted between December 1982 and March 1983 revealed evidence of late-Quaternary offset along the Hunting Creek fault. A paleosol estimated to be 32,000 to 75,000 years old is offset, but SRK-WCC concluded that overlying colluvium observed in trench 3 was not faulted. However, this writer concludes that there is evidence indicating that Holocene-age material is offset in trench 3 and in test pit 1A (figures 6,7). Air photo interpretation of 1952 USDA air photos and field observations made by E.W. Hart and this writer since FER-137 was prepared generally confirm the fault traces originally recommended for zoning for special studies. Minor differences exist, but these are due principally to differences in scale and resolution of the two sets of air photos interpreted.

RECOMMENDATIONS

Traces of the Hunting Creek fault recommended for zoning for special studies in FER-137 should remain as shown on figure 4, except for the minor changes indicated, based on air photo and field interpretations by Hart and Bryant.

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I agree with the recommendations.
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5/25/83

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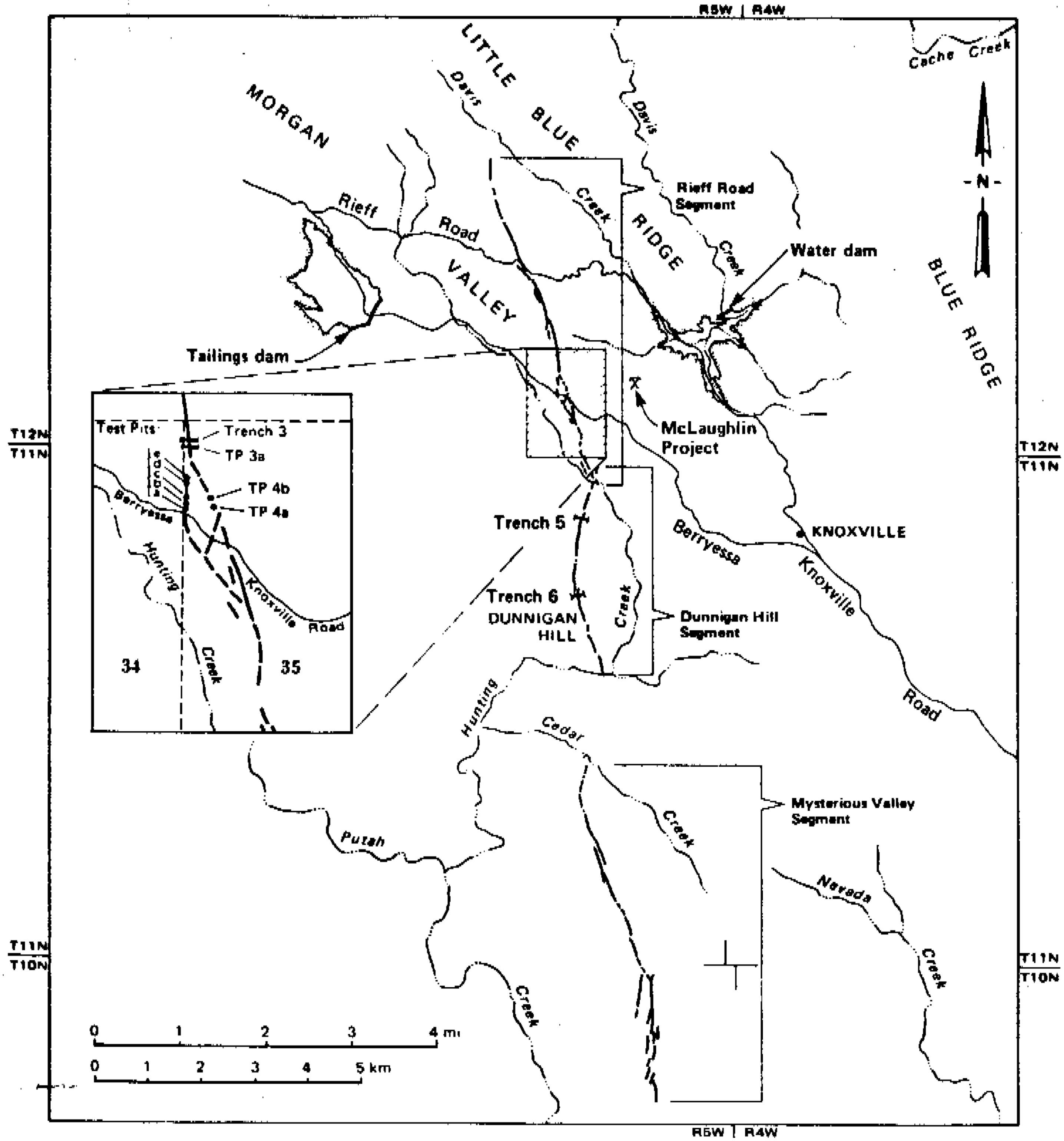
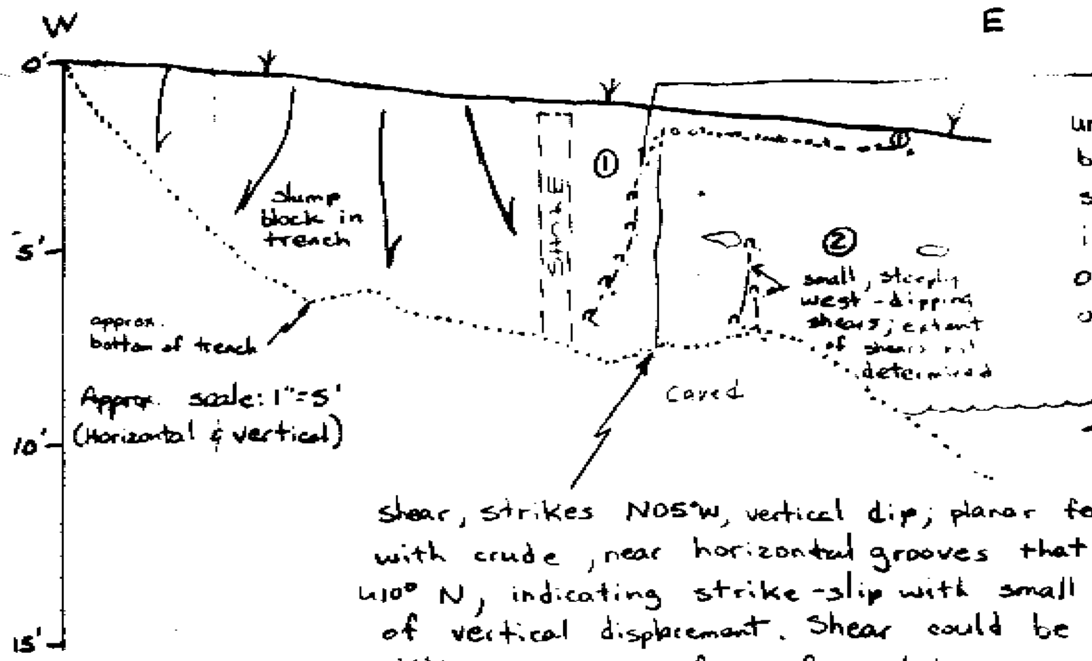


Location of Hunting Creek fault zone after Bryant (1982a)

Figure 5 (supplement to FER-137). Rieff Road, Dunnigan Hill, and Mysterious Valley segments of the Hunting Creek fault. Locations of trench excavations by Woodward-Clyde Consultants are shown. Map from SRK-WCC (1983).

Figure 7 (supplement to FER-137). Sketch of north wall of TP 1a observed by Bryant. See figure 5 for location.



unable to determine if contact between ① & ② gradational or sharp. Also, it was not determined if additional soil horizons or paleosols occurred west of shear zone

trench full of water to E

shear, strikes N05°W, vertical dip; planar feature with crude, near horizontal grooves that plunge ≤10° N, indicating strike-slip with small component of vertical displacement. Shear could be traced to within 17 inches of surface, but may extend to within 6 inches of surface.

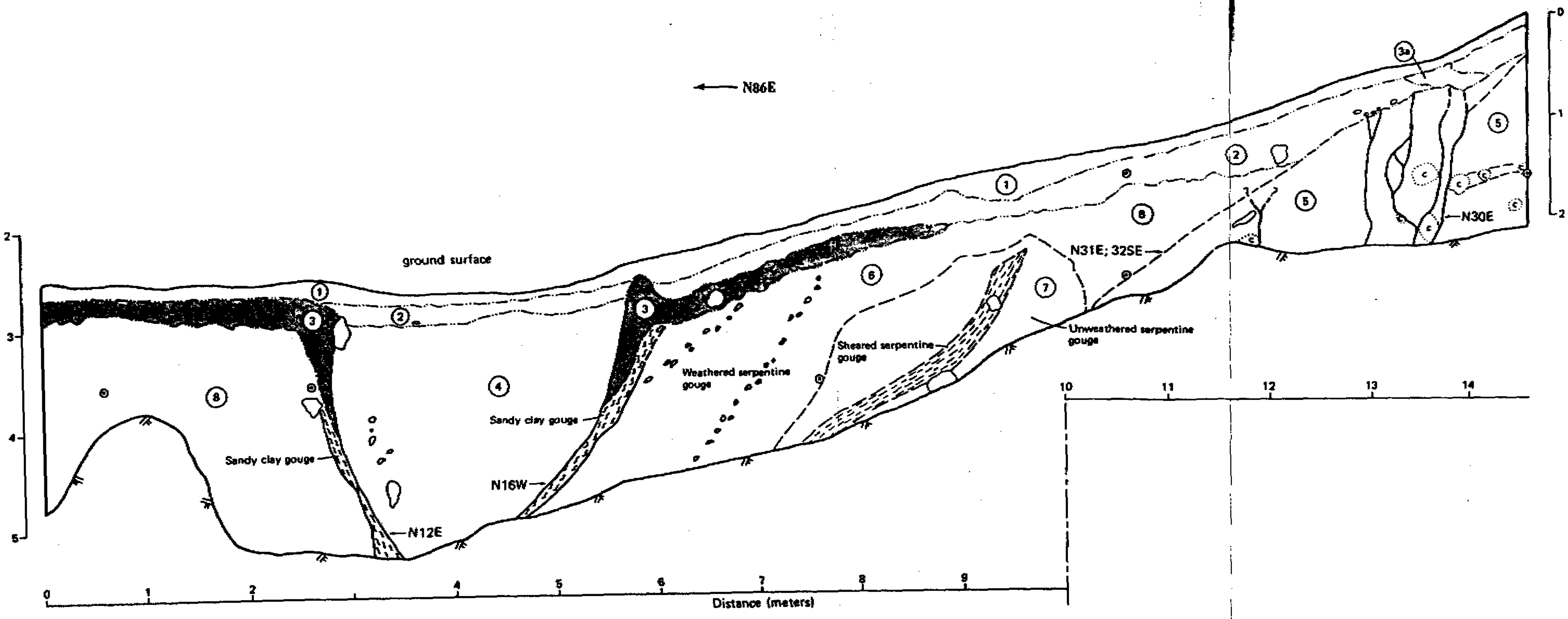
① dk. brown clayey silt(?), stoney, probably colluvium. Stoneline at base of this unit is possibly displaced by shear - not conclusively demonstrated.

② yellow-brown silty clay with hard pebbles & cobbles. Silty clay is plastic, internally sheared (shrink-swell?). It was not determined if clasts randomly oriented, bedded, or imbricated. Clasts range in size from 0.2cm to 30cm in diameter. Clasts that were examined are generally angular, although some have at least one rounded surface, suggesting some amount of transport

Diagrammatic sketch of N wall of trench (TP 1a) across Hunting Creek fault.

Note: all dimensions are only approximate - this sketch portrays general impressions only - not intended to document features observed in trench on 12-21-82. Trench observed in heavy rain - many subtle features may not have been observed W.A.B. 12-23-82

Figure 6 (supplement to FER-137). Log of trench 3 excavated along the Rieff Road segment of the Hunting Creek fault. See figure 5 for location. Log from SRK-WCC (1983).



EXPLANATION

Nail marking level line

Pebbles, cobbles, and boulders

Core stone of more resistant serpentine

Shear fabric

Soil Horizon Boundaries (width of transition zones between horizons)

Abrupt; 1 mm to 2.5 cm

Clear; 2.5 to 6.0 cm

Gradual 6.0 to 12.5 cm

Bedrock Contacts

Lithologic contact

Shear; dashed where uncertain

Bottom of excavation

SOIL UNITS

1 Topsoil developed on recent colluvium

2 Recent colluvium

3 Residual paleosol developed on weathered bedrock

3a Sandy clay similar to unit 3

Bedrock Units

4 Sag fill and clay gouge

5 Serpentinite gouge

6 Weathered and iron-stained serpentinite gouge

7 Unweathered serpentinite gouge

8 Weathered serpentinite gouge

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FIGURE D-1
LOG OF TRENCH 3
HUNTING CREEK FAULT ZONE

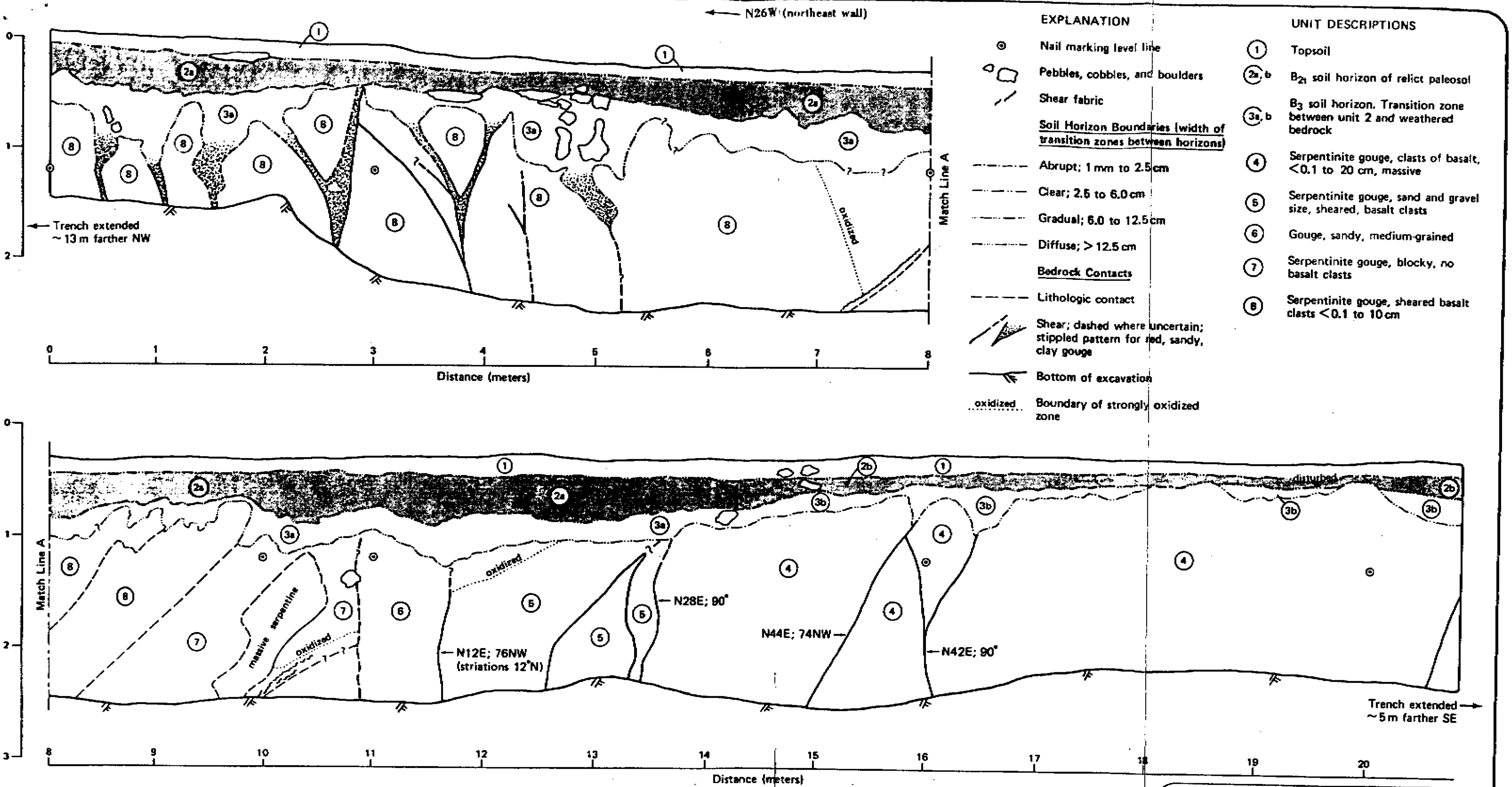

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FIGURE D-2
LOG OF TRENCH 5
HUNTING CREEK FAULT ZONE

Figure 8 (supplement to FER-137). Log of trench 5 excavated along the Dunnigan Hill segment of the Hunting Creek fault. See figure 5 for location. Log from SRK-WCC (1983).